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ABSTRACT

This booklet provides gereral information on minority women (Blacks, Hispanics, Asian Americans, and American Indians) in math and science careers and profiles of specific women in these fields. Part 1 gives brief profiles (approximately 150 words each) of 40 minority women in math and science careers. Each biography gives the individuals' current job, educational background, hobbies, and her suggestions to young women. In some cases personal information about the woman's family is given. Part 2 consists of a discussion of the barriers encountered by minority women in all phases of career pursuit from childhood discouragement through difficulty in obtaining promotions once in their chosen field. These observations are supported by personal statements of women who have encountered these barriers. The booklet ends with a glossary of terms, a table showing numbers of men versus women in a variety of scientific and mathematical fields by race, and, finally, a listing of professional fields of study showing how much high school preparation is required for entry into these fields. (CG)

MINORITY WOMEN IN MATH AND SCIENCE

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DEVELOPING MULTI-MEDIA CURRICULUM AIDS FOR TEACHING ABOUT MINORITY WOMEN

Minority Women in Math and Science

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Linda Garrett and Rhoda Miller Stroud
K-12 Curriculum Specialists on Minority Women
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St. Paul Public Schools
Urban Affairs Department
St. Paul, Minnesota

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September 1982

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Grant #G007901081

PREFACE

"Developing Multi-Media Curriculum Aids for Teaching About Minority Women" was a two-year project (1979-81) funded by the Women's Educational Equity Act Program, U.S. Department of Education. It was based on the needs for students to understand the status, needs, and contributions of American women of color, i.e., American Indian, Asian American, Black, and Hispanic, and for teachers to have materials and assistance in teaching relevant aspects of history, culture, and contributions of these women in their classrooms. The purpose of the project was to develop multi-media curriculum aids for teaching about the four groups of minority women in a variety of subject areas in elementary and secondary curriculum systems.

The work and commitment of many people is represented in this project. Although housed within the St. Paul Public Schools, educators from suburban and urban school districts throughout the state were involved in the field testing of the multi-media curriculum aids. Through their efforts, a variety of materials were developed for use in elementary and secondary classrooms. These materials include four elementary kits, one on each group of minority women, a secondary booklet on minority women in math and science, secondary poster sets on young minority females and their role models, and an in-service training manual for preparing teachers to use the multi-media curriculum aids.

This booklet has two goals: to provide information on minority women in math and science and to acquaint you with some of the minority women who are working in math and science careers.

In the past, women who entered math and science fields did so at great odds. Usually, they had to be exceptionally bright and overcome many obstacles. The situation is changing today. More women are entering math and science, and many young women are beginning to think of a career in these fields. Men still outnumber women in most math and science professions. However, this fact should not prevent young women from considering a career in a non-traditional field.

Included in the numbers of women in math and science fields are small numbers of minority women. Progress for them has been slower because of barriers due to both their race and sex. In fact, some people are not even aware of their existence as well as contributions in math and science.

A common myth about women who are in math and science careers is that they are not in dual roles involving families and careers -- that they are solely career-oriented. Some of the women who are featured in this book wanted readers to know about their families. Some of them did not. A variety of life styles is represented and because a woman did not share information about her family, assumptions should not be made about her marital and/or parental status.

We hope that by reading about the various women in this book, you will better understand that math and science careers can and should be options for anyone, regardless of race and sex. These women are role models for all of us.

Many minority women contributed their thoughts to this booklet. Without their help, we would not have been able to develop it. Our sincere appreciation and thanks to all the minority women in math and science who have assisted us.

TABLE OF CONTENTS

COLLEGE PROFESSORS

Dr. Elma Gonzalez
Professor of Biology

Dr. Elma Gonzalez is a professor at the University of California, Los Angeles. She teaches graduate and undergraduate students as well as conducts research in plant cell biology.

She remembers that her father had a great curiosity about nature and living things. His curiosity encouraged her to pursue a career in biology. Dr. Gonzalez received her bachelor's degree from Texas Women's University and her doctorate degree from Rutgers University. She has received fellowships from the National Institute of Health and the Ford Foundation.

Dr. Gonzalez believes that young women should think of the future as they will probably have to work for twenty to thirty years, and it is better to have choices about careers and jobs.

Dr. Marie Ethel Morisawa
Professor of Geology

Dr. Marie Ethel Morisawa is a geology professor at the State University of New York. She teaches geology courses and conducts research on topics such as earthquakes and water resource systems.

She has always had an interest in earth science and her college professors encouraged her to pursue her studies in geology. She obtained her bachelor's degree from Hunter College in New York, her master's degree in geology from the University of Wyoming, and her doctorate degree in geology from Columbia University in New York.

Dr. Morisawa is actively involved in professional societies. She is a recipient of numerous research grants and fellowships which have aided her in her study of the environment. In addition, she has written many articles for journals and textbooks.

Her suggestions to young women are to keep plugging away, be yourself, and be the best that you are.

Mamie Wong Moy
Associate Professor of Chemistry

Ms. Mamie Wong Moy is an associate professor at the University of Houston. She is a lecturer, instructor, assistant chairperson, and academic advisor to all undergraduate chemistry majors.

She received her bachelor's degree in chemistry from the University of Texas in Austin and her master's degree in chemistry from the University of Houston. She decided to become a college teacher when she discovered that she was able to help a large number of students in chemistry, a subject considered to be very difficult.

Ms. Moy was recently honored by her university for teaching excellence. She is actively involved in several projects such as a scholarship project sponsored by an organization of professional Chinese American men and women. Another is the promotion of science, particularly chemistry, among women. She also acts as a high school faculty liaison to encourage teachers to encourage their students to become more involved in chemistry.

Ms. Moy encourages young women to take full advantage of all educational opportunities and to take as many of the career preparation courses as possible. They should also participate in decision and policy-making groups or committees such as student associations and clubs.

Dr. Elvira L. Paz
Associate Professor of Food Science

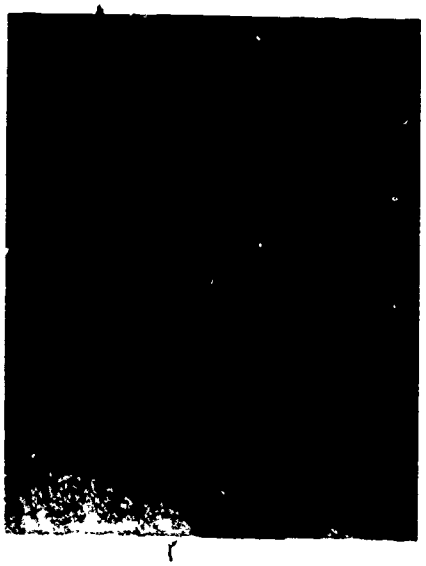
Dr. Elvira L. Paz teaches courses in general science, microbiology, and food chemistry at the University of the District of Columbia. Besides instructing students, she prepares most of the course materials for those subject areas.

Dr. Paz graduated from the National Polytechnical Institute's School of Biological Sciences in Mexico. She received a bachelor's degree in chemistry. Then, she came to this country and attended Southern Connecticut State College where she earned a master's degree in science education. She received her doctorate degree in biology from Wesleyan University in Connecticut.

Dr. Paz has two sons and enjoys swimming, skating, and music. She is very active in promoting science fairs and participates in professional as well as community organizations.

She encourages young minority women to prepare themselves by taking science and math courses and achieving high grades. Such preparation is needed for survival in the male-dominated science field.

Dr. Jeanne C. Sinkford
Dentist/Dean/Professor



Dr. Jeanne C. Sinkford is a dentist, dean, and professor at Howard University in Washington, D.C. She is the chief administrator for educational, research, and patient treatment services for the College of Dentistry.

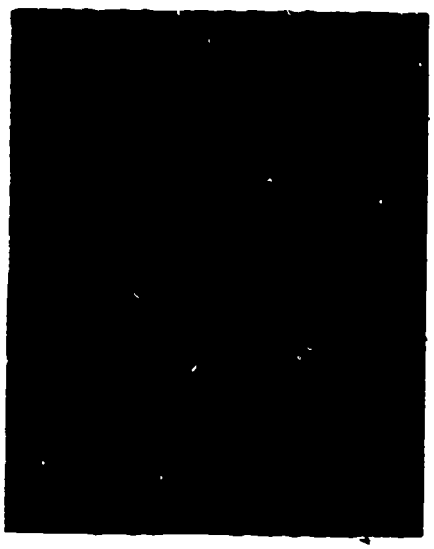
When she was attending college, Dr. Sinkford developed a personal desire to do research and to treat patients. She received her bachelor's degree and a degree in dentistry from Howard University. She also attended Northwestern University where she earned a master's degree in science and also a doctorate degree. Her mother and three sisters have been supportive and encouraged her in her goals. They also helped in financing her education.

Dr. Sinkford is married and the mother of three children. Her special interest is adolescent health. She is active in a number of professional and community organizations. Her hobbies include bowling and music.

Dr. Sinkford's suggestions to young women include:

1. Know what you are "good at" and what you enjoy doing;
2. Prepare yourself educationally;
3. Seek professional advice as to career opportunities, scholarships, and educational opportunities;
4. Do not be afraid.

Dr. Geraldine Williams Twitty
Professor of Zoology



As a college professor of zoology at Howard University in Washington, D.C., Dr. Geraldine Williams Twitty coordinates staff and student activities in general zoology. She is also involved in undergraduate seminars and research.

She has always had a love for zoology and a desire to help in the training of zoologists. She feels that these two concerns contributed to her interest in her career. Dr. Twitty received her bachelor's and master's degrees from Howard University and her Ph.D. from the University of California in Los Angeles.

She is married and the mother of twin daughters. Her special interests are cancer

research and working with youth who are interested in zoological sciences. She is also active in church activities. Her hobbies include gardening and photography.

Dr. Twitty suggests that young women develop a solid background in science by taking full advantage of all science and math course offerings. They should also take advantage of as many summer programs in the sciences as they can.

Dr. Joyce M. Verrett
Professor of Biology

Dr. Joyce M. Verrett is a professor of biology and chairperson of the Division of Natural Sciences at Dillard University in New Orleans, Louisiana. Her work involves administration, budget supervision, coordination of instruction, and recruitment of faculty. She also advises students. She is the first woman chairperson in science at her university in 110 years.

Dr. Verrett did not enter college until she had been out of high school and married for three years. At first, she wanted to be a nurse but, because of an illness, she had to drop out of school. When she returned, she entered the field of biology and decided to have a career in that field. She graduated from Dillard University with a bachelor's degree, received her master's degree from New York University, and was the first Black woman to get a Ph.D. degree in biology from Tulane University in New Orleans.

A recipient of numerous awards, Dr. Verrett is known throughout the world for her research on the cockroach. She recently has been doing research on the water balance in the American cockroach.

Besides being a mother and active in her career field, she participates in various organizations. Her hobbies include reading and science.

Dr. Verrett suggests that female students take all the mathematics they can and not fear being the first to do something usually done by men.

ENGINEERS

Kanchana Boonarkat Ballowe
Process Engineer

Kanchana Boonarkat Ballowe is employed as a process engineer by Honeywell Incorporated Residential Group in St. Louis Park, Minnesota. She is currently working on a feasibility study project in advance electronic assembly to reduce cost, to increase reliability, efficiency, and productivity of printed wiring board assemblies.

She has enjoyed studying science and math subjects since she was a child in Thailand. While in the tenth grade, she served as science paper editor and president of the science club. She came to this country as a student and attended Southwestern Adventist College in Texas. It was there that her science professors encouraged her to become a scientist. She received her B.S. degree in chemistry from the University of Alabama in Huntsville. She has been taking additional courses in business and management and hopes to become one of the corporate executives. Challenging projects and interpersonal relationships presented in her work assignment bring her much satisfaction. Her previous positions included: analytical chemist, quality control director, laboratory supervisor, production engineer, and marketing.

In addition to her family and career, Ms. Ballowe is very active in church activities as a youth leader. She is a member of various professional organizations including Society of Women Engineers and Association for Women in Science. She was active in the formation of the Minnesota chapter of Women Engineers.

Ms. Ballowe suggests that young women set high goals and pursue them irregardless of barriers.

Olivia L. Chen
Environmental Engineer

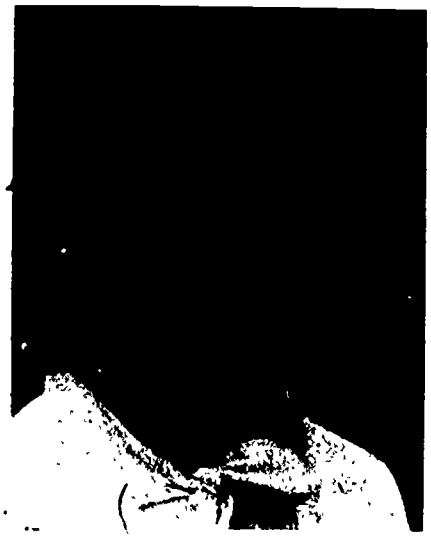
As an environmental engineer for Metcalf and Eddy Incorporated in Palo Alto, California, Olivia L. Chen is responsible for the planning, managing, and production of projects in water supply and wastewater treatment fields. Her work has involved nearly all aspects of environmental planning: water resources management; water supply, treatment and distribution; wastewater collection, treatment and disposal; stormwater management; water conservation; and wastewater reclamation.

Originally from Taiwan, Ms. Chen received her bachelor's degree from Cheng Kung University. She obtained her master's degree in sanitary engineering from Stanford University in Palo Alto. At the present, she is the only female manager among a total staff of 900 employees.

Ms. Chen has two children. In addition to her family and her work, she participates in various professional societies and community affairs. She has been active in the career development programs of universities and high schools. And, she is particularly interested in providing assistance in improving the involvement of women in engineering.

Her advice is to be aware of who you are, your potential, and what you want to do.

Minh Thi Dai
Process Engineer



Minh Thi Dai is a recent graduate of the University of Minnesota where she majored in chemical engineering. She is now working as a process engineer in the Research and Development Laboratories of the Pillsbury Company.

Mrs. Dai came to this country from Vietnam in 1975. She has always liked science and math courses and got good grades in them. When she was in high school, she received top honors in science.

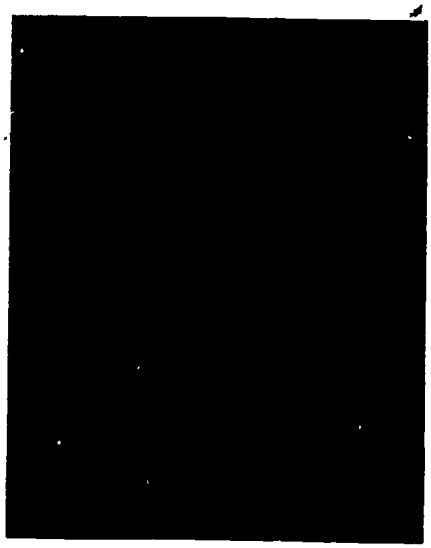
She graduated from college with a teaching degree and taught for fourteen years in Vietnam. Then, she decided to attend pharmacy school. However, the Vietnam war prevented her from completing the pharmacy program.

When she and her family came to this country, she worked in a hospital. Mrs. Dai decided to go back to college to pursue a degree in chemical engineering. She successfully attained this goal.

She has four children and is active in the Vietnamese League. She helps many of the new Indochinese refugees who are resettling in her community.

Mrs. Dai believes that when you like something, you do better in it. Science fields, like pharmacy and medicine, are often difficult and limited for women. Hopefully, things will change. Meanwhile, it is important to keep trying.

Judith Forbes-Resha
Engineer



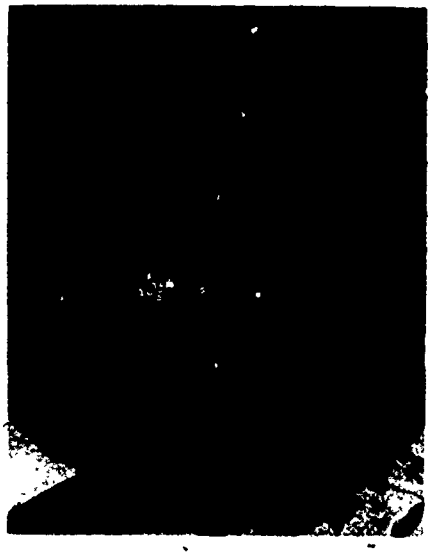
As an engineer with TRW in Anaheim, California, Judith Forbes-Resha coordinates the efforts of the prime contractors for the MX missile program and acts as technical advisor to the Air Force. In this position, she compares the analysis of the parties involved and advises on which one or which combination is the most correct.

Ms. Forbes-Resha has been interested in missiles and the space program since the Russians launched Sputnik in 1957. Sputnik was the first human-made orbiting object which generated national concern in this country about the quantity and quality of our science programs. Sputnik was a significant event that interested her in a science career. She graduated from college with a degree in physics and obtained a master's degree in engineering.

She is married and has three children. Her hobbies include flying, piano, painting, and bowling. In addition, she has formed with three other persons, a new company called Alternative Energy Concepts. This firm will market solar systems for heating swimming pools and spas. Each system will be tailored to the buyer's home and will be sold in a do-it-yourself kit.

Ms. Forbes-Resha traces her ancestry to Cherokee descent. Her recommendation to young people who are interested in a career similar to hers is to get as broad a background as possible. That is, take all the math possible and participate in team activities. Participating as a team member is a skill necessary in her kind of work.

Rosa F. Frost
Process Engineer Specialist



Rosa F. Frost works for the 3M Company in St. Paul, Minnesota. As a process engineer specialist, she develops new processing technologies for current 3M products such as traffic signs and new product ideas for manufacturing.

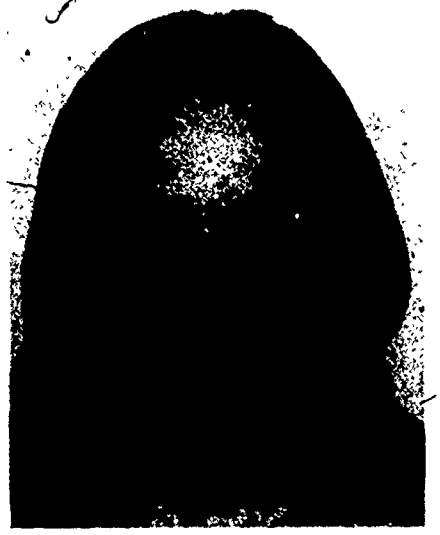
Ms. Frost had a major interest in science and math when she was young. Her childhood town in Peru had a sugar cane processing plant where her father worked, and many of his friends were engineers. In addition, her oldest brother became a chemical engineer. She thought that there would be challenging career opportunities in engineering and decided on a career in that field.

To prepare herself, Ms. Frost majored in chemical engineering at National University in Trugillo, Peru. She received a master's degree in that subject area at Arizona State University.

Ms. Frost is married and has a son. Her hobbies include piano, accordian, painting, jogging, gardening, reading, and tennis. She is also active in teaching math, reading, and spelling to elementary school children. Her involvement in education includes talking to high school female students about careers in science and technology.

Her advice to young women is that science and math are worthwhile subjects to be taken in school -- the earlier, the better. She has found her career to be very rewarding from many points of view -- economically, socially, and personally -- and hopes that young women will think seriously about a career in engineering.

Elizabeth Garcia
Chemical Engineer



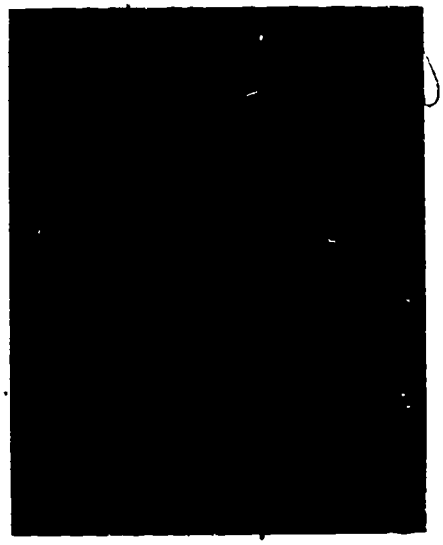
Elizabeth Garcia is employed as a staff engineer-supervisor by the Exxon Chemical Company in Florham Park, New Jersey. She supervises a team of five to six engineers in the planning, development, and designing of energy-saving techniques for chemical plants.

She has found that her career is very practical and that it has helped her become handy at fixing things at home. It is also satisfying for her to see her ideas implemented at the plants. Ms. Garcia majored in chemical engineering at a university in Cuba and received a master's degree from the New Jersey Institute of Technology. She has also taken special courses in leadership skills.

Ms. Garcia is married and has a daughter. She belongs to various professional organizations and enjoys photography, sports, reading, and coin collecting.

Her advice is to consider a career in engineering as more and more companies are realizing that women can do a great job in that field.

Velda Cynthis Jones
Civil-Environmental Engineer



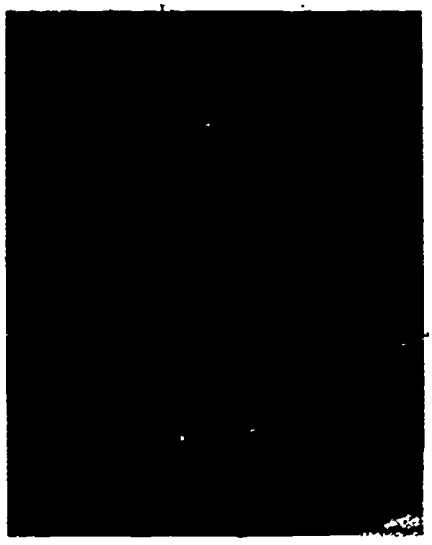
Velda Cynthis Jones is a civil-environmental engineer with I.C.I. American Company in Delaware. Her duties and responsibilities include designing wastewater and other pollution control systems for I.C.I. plants, monitoring existing treatment systems, and obtaining pollution control permits from government agencies.

Ms. Jones was encouraged to pursue engineering by her high school counselor who recognized her math and science aptitude. Summer jobs at an oil refinery provided further incentive for her to continue studying. She received a degree in civil engineering from the University of Delaware in 1979 and became the first Black woman to receive such a degree at that school.

Ms. Jones feels that her family and husband have been very instrumental in her success. They have given her support and encouragement. Her special interest is in young people, and she is involved in various high school and community programs which expose students to engineering and industry. Her hobbies include reading, creative writing, bowling, and horseback riding.

In regard to young women, Ms. Jones suggests that "they take courses which will give them the strongest possible background in math and science." They should also choose a college that has a good reputation and will provide a quality education.

Maria Magaña
Electrical Engineer



Maria Magaña is an electrical engineer employed by IBM Corporation in San Jose, California. Her work focuses on the design and development of disk drivers for IBM computers.

Ms. Magaña started out as a math major in college. During her freshman year, she became interested in the math-computer science program that was developing at the University of California in Los Angeles. She received her master's degree in electrical engineering and computer science from the University of California at Berkeley.

Ms. Magaña is married, and most of her hobbies revolve around outdoor activities such as running, backpacking, bicycling, and sailing. She also devotes time to projects involving science programs for children. One of these projects was a children's television series on science and technology. Another is a lecture program for secondary schools.

Her recommendation is that young women continue to explore science courses even though they may seem difficult because science will be playing a larger role in our lives in the future.

Isabella J. Cole
Mathematician

An early interest in computers and a desire to share her understanding of them led Isabella J. Cole to become a mathematician. She is presently employed as an operations research analyst for the National Aeronautics Space Administration in Greenbelt, Maryland. Mrs. Cole is responsible for the design, implementation, maintenance, and generation of data sets for the manpower analysis and planning systems for a resource analysis group.

To prepare herself for such a career, she majored in mathematics at Shaw University in Raleigh, North Carolina. In addition, she took computer-oriented mathematics courses at the University of North Carolina, George Washington University, and the University of Maryland.

Mrs. Cole suggests that young people prepare themselves for their future careers by choosing a skill to learn. "Persevere and be serious about your choice," she concluded. Her advice reflects in her work as she has been employed by the federal government since 1943. In addition to her work, Mrs. Cole raised three daughters and has actively participated in community work at her church.

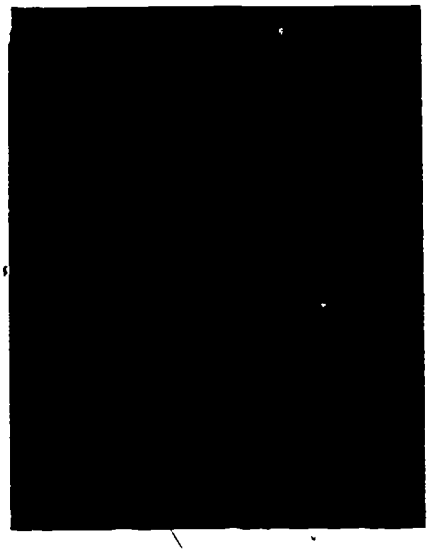
Diane E. Palmer
Accountant

Diane E. Palmer is an accountant who owns her own firm, Palmer Financial Consultants. She provides accounting, record keeping, budget control, tax, computer, and financial consulting services to her clients.

During her high school years, Ms. Palmer worked with the financial records of her church. When she went to college at eastern Illinois University, she majored in sociology and social science with a minor in business. She also took post-graduate courses in business and accounting. After college, she worked as an accountant with various businesses.

Ms. Palmer is active in numerous activities. She is very involved in a financial consulting service for senior citizens and low-income persons who cannot afford these services. She is also working to help young people consider the fields of finance and accounting for their future careers.

Dr. Lucy Wu Person
Computer Scientist



Dr. Lucy Wu Person is an assistant computer scientist employed by Argonne National Laboratory in Illinois. She is in charge of and designs interactive computer systems related to transportation systems and the national transportation energy need.

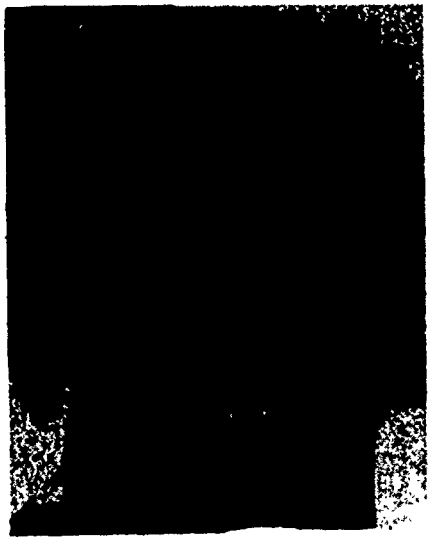
Dr. Person was born in Shanghai, China, and raised in Taiwan. Her parents encouraged her in her studies, and she did very well in them. She graduated from the National Taiwan University with a bachelor's degree in chemical engineering. She came to this country to study at the University of California in Berkeley and received her Ph.D. in chemistry. She is presently working on a master's degree in business administration at the University of Chicago.

In addition to being a wife and a mother of three teenagers, Dr. Person spends her spare time working with Chinese American organizations and church activities. Because she is bilingual, she also acts as a interpreter when delegations from China visit her place of work.

Dr. Person's suggestions include the following points:

1. Have confidence in your ability;
2. Take four years of mathematics and science subjects;
3. Work on oral and written communication skills;
4. Talk with women scientists and engineers.

Tauriette C. Ray
Mathematics Teacher



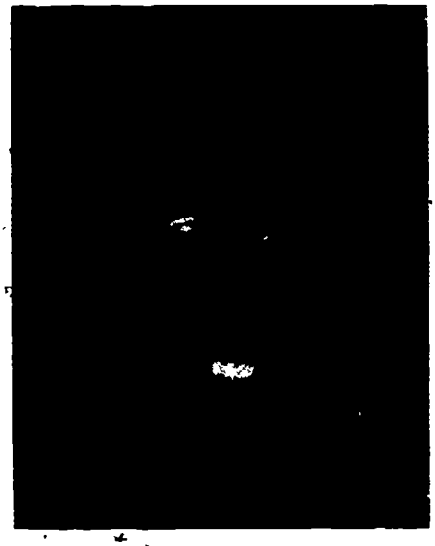
Tauriette C. Ray has taught math to junior and senior high school students in St. Paul Public Schools in Minnesota. She presently teaches algebra, geometry, and general math courses in a junior high school.

Her interest in math, encouragement from high school teachers, and support from her parents are factors which contributed to her interest as a math educator. Ms. Ray received her bachelor's degree in math education from Alabama State University, her master's degree in education from the University of Minnesota, and has taken additional graduate work at various colleges and universities.

Her hobbies include reading historical novels, bowling, and outdoor activities such as roller-skating and skiing. She also belongs to the National Council of Teachers of Math and is active in state and local activities of this group.

Ms. Ray believes that young women should develop good study habits and persevere in their endeavors. "Don't look back at past mistakes, but keep pushing for a better personal future."

Valerie L. Thomas
Data Analyst



Valerie L. Thomas is a mathematician/data analyst at the Goddard Space Flight Center (GSFC) operated by the National Aeronautics and Space Administration (NASA) in Greenbelt, Maryland. She manages the development of image processing computer software systems which support satellites such as Landsat. She has to interact with individuals, companies, agencies, and representatives of different countries in resolving issues such as changing requirements and problems with various image-processing systems.

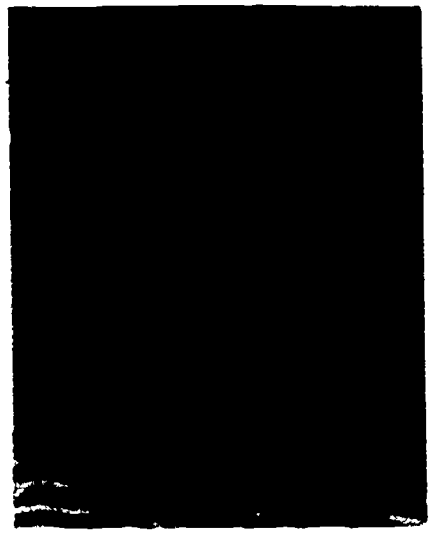
Ms. Thomas became fascinated with image-processing computer software systems when she worked on an earlier project that demonstrated the possibility of using satellite images to develop a world-wide crop inventory system which can be used to predict wheat yield. She has taken courses in computer science, engineering, behavioral science, and management to become more competent in her field. She has a bachelor's degree in physics and mathematics from Morgan State University in Baltimore, Maryland.

A recipient of several achievement awards, Ms. Thomas is interested in working with groups concerned with developing programs and activities which will increase opportunities for minorities and women in science and engineering.

She is the editor of the journal for the National Technical Association and also on its board of directors, an active member of Women in Science and Engineering, and editor of the newsletter, Blacks in Government. Her hobby is sewing.

Ms. Thomas suggests that one take as much math as possible because it will be helpful in any technical area. In addition, it is helpful to get some "hands on" experience in technical fields by participating in special programs for students sponsored by private companies, the government, or universities.

Dr. Bertha Trevino
Retired Mathematician



Dr. Bertha Trevino is now retired from a career in math. She is the former head of the math department of Loredo Junior College in Loredo, Texas. In this capacity, she was responsible for scheduling courses, planning new courses, evaluating instructors' performances, and keeping in close contact with members of her department.

When she attended college, teaching was the only profession open to a Mexican American female in San Antonio. She obtained a bachelor's degree in Romance languages from Our Lady of the Lake in San Antonio, Texas, and a master's degree in math from the University of Michigan. National Science Foundation scholarships in math enabled her to do more graduate study. As a result, she attended the University of Texas where she earned a master's degree in educational psychology and a Ph.D. degree in mathematics education.

Dr. Trevino has received numerous awards and recognitions. She was honored with a request from the White House for a copy of her dissertation entitled, "An Analysis of the Effectiveness of a Bilingual Program in the Teaching of Mathematics in the Primary Grades."

Now widowed, Dr. Trevino has two adult children. Her hobbies include gardening, card playing, and reading. Her recommendations to young women are that studying eventually pays back and to be aggressive and articulate.

MEDICAL PERSONNEL

Dr. Susan Crutchfield-Mitsch
Physician and Insurance Company Medical Director

Dr. Susan Crutchfield-Mitsch, a physician, is a vice president and the medical director for Prudential Insurance Company in Minneapolis, Minnesota. She is responsible for conducting physical examinations on insurance applicants and company executives. And, she assists other departments in resolving claims.

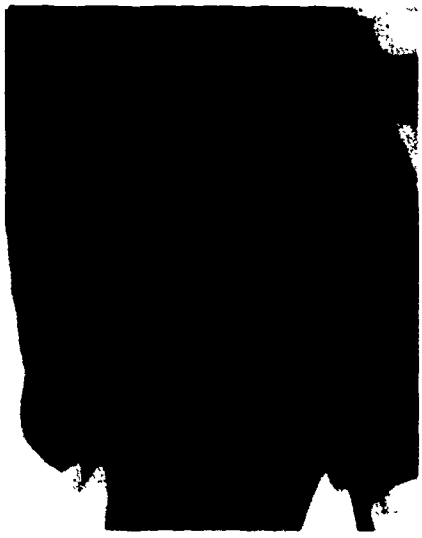
When she was seven years old, her pediatrician impressed her, and she thought that the medical field would be rewarding. She received her bachelor's and medical degrees from the University of Minnesota. Prior to joining Prudential, she practiced family medicine for several years.

She participates in various community and professional organizations. She is a member of the boards of the American Academy of Family Practice and Association of Life Insurance Medical Directors. She also serves on the board of directors of the University of Minnesota's Medical Alumni Association.

Dr. Crutchfield-Mitsch is married and has four sons. She enjoys tennis, gardening, and karate.

Her suggestions are to set goals, do well in school, and meet people who can help you in choosing a career.

Angeles Juárez
Registered Nurse



Angeles Juárez is a registered nurse who is employed at a neighborhood health center. She coordinates the medical services at the clinic and assists in educating patients about health concerns.

Ms. Juárez has always liked to work with people. She also thought that nursing would be a challenging and exciting profession to go into. As a result, she got a degree in nursing from the University of Mexico and worked in different hospitals in Mexico City. She came to this country in 1975.

Ms. Juárez is married and has a child. Her hobbies include reading and music. She enjoys working with teenagers in regard to family planning.

Her advice to young women is to work hard and discipline yourself. It is possible to reach your goals.

Janet Macon McCoy
Field Representative

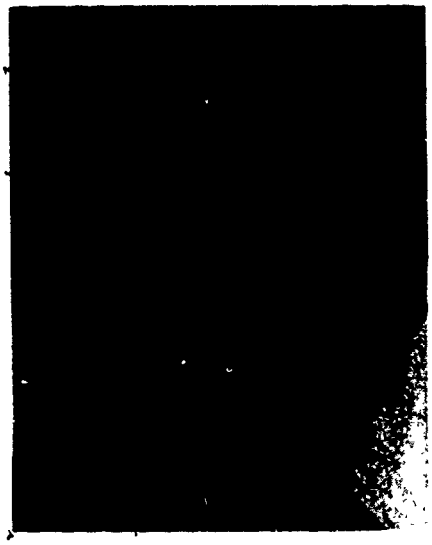
As a field representative for the Minnesota Nurses Association, Janet Macon McCoy is involved in negotiating work contracts for nurses throughout the state. She also educates others on collective bargaining. She became interested in this kind of work when she realized that nurses were low paid, and she wanted to do something about this situation. She assisted in organizing the first nurses' strike in Minnesota.

Ms. McCoy has a bachelor's degree in nursing from Winston-Salem State University in North Carolina and a master's degree in nursing from Indiana University. She participates in numerous workshops to increase her skills and knowledge.

She is married and has five children. Ms. McCoy is very active in her church.

Her advice to young women is to set high standards and goals and make every effort to work towards those goals. If you can't achieve them at first, keep trying. Don't be discouraged.

Dr. Sylvia M. Ramos-Burch
General Surgeon



Dr. Sylvia M. Ramos-Burch is a general surgeon on the faculty and attending staffs at Albert Einstein College of Medicine in New York. She is responsible for the supervision and teaching of students, interns, and residents in the areas of patient care and operating room techniques and procedures. She also is the Educational Programs Coordinator in charge of minority student affairs at the college.

Her motivation for going into medicine resulted from her talents and desire to help people. Her undergraduate degree is from Herbert H. Lehman College of the City University of New York, and her medical degree is from Albert Einstein College of Medicine. In addition, she took surgical training for four years at various hospitals in New York.

Dr. Ramos-Burch has a daughter. She is interested in the history of medicine and plans to write articles on this subject. She is also involved with a project in the South Bronx area of New York. This project is aimed at teaching junior high students about careers.

Her advice to young women includes the following points:

1. Know and believe that women as well as men can and do perform the same jobs.
2. If a career in medicine is your goal, strict discipline is necessary for academic achievement. It is very important to lay a good academic foundation while in high school.
3. Being a doctor means many years of preparation. What may seem an extremely long period of time spent in preparation is actually short in relation to time spent as a practicing physician. It is important to realize this aspect.

Susan Wong
Occupational Therapist

As an occupational therapist, Susan Wong is responsible for planning and carrying out treatment for physically handicapped people at St. Paul-Ramsey Medical Center in Minnesota. She also supervises aides and occupational therapy students, counsels families of patients, and educates medical students about occupational therapy.

She has always had a strong interest in a medical profession. As a high school student, she did volunteer work for a day activity center for mentally retarded students. When she registered for college, she participated in a health sciences day and toured the occupational and physical therapy schools. She decided on a career in occupational therapy and graduated from the University of Minnesota with a bachelor of science degree in that field.

Ms. Wong participates in professional and community organizations. She also enjoys numerous hobbies such as piano playing, cooking, photography, volleyball, tennis, golf, and skiing.

Ms. Wong suggests to young women that if they are interested in a job in the medical field to tour and volunteer in that job's setting. Volunteer experience is very helpful in making decisions about one's career.

PROGRAM DIRECTORS

Dr. Rayna D. Green
Program Director

Dr. Rayna D. Green is a program director for the American Association for the Advancement of Science. Her responsibilities include directing a project to develop Native American scientific and technical expertise and supporting the study of Native American science, medicine, and technology.

Although she is employed in a career focusing on science and math, she did not major in those fields in college. Rather, she got her bachelor's and master's degrees in English. Her Ph.D. is in folklore and American studies. Her continuous work in the Indian community and various Indian institutions, her experience as a Peace Corps worker in Ethiopia, and teaching in a number of colleges and universities throughout the country have been factors which have influenced her career choice today.

Dr. Green is a Cherokee Indian. She is currently working with various Indian scientific and technical groups to attract more Indian youth into scientific and medical careers. She also is working with them to develop professional training programs for Indian women. In addition, Dr. Green writes articles on topics such as American Indian folklore, Indian women, Indian traditional science, and Indian stereotypes.

Dr. Green recommends that young women take math, calculus, and all the basic sciences. It is also imperative to learn to write and speak well and learn how institutions operate and affect people as individuals.

Paula Quick Hall
Program Associate

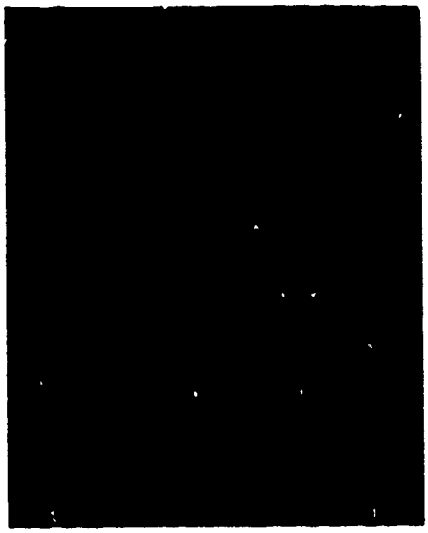
As a program associate employed by the American Association for the Advancement of Science, Paula Quick Hall is involved with the research of minorities and women in science. She collects, writes, and disseminates information on the participation of minority group members and women in science. She also organizes activities to increase their participation. One activity was a conference on minority women scientists.

Ms. Hall graduated from Howard University with a bachelor's degree in psychology. Her interest in science careers developed when she realized that she could assist in influencing opportunities, attitudes, and public policy regarding minorities and women in science.

Ms. Hall is a wife and mother of two children. In her spare time, she enjoys her hobbies -- painting, carpentry, crocheting, reading, and games.

Her advice is to take all the math and science courses which are available and to visit many working women at their job sites in order to observe, ask questions, and learn about working conditions.

Dr. Classie G. Hoyle
Director of Affirmative Action
Assistant Professor in Science Education



Dr. Classie G. Hoyle holds dual job responsibilities. She administers the affirmative action program at the University of Iowa. In addition, she has teaching responsibilities with the teacher education program at the Science Education Center.

Dr. Hoyle credits high expectations from teachers and counselors as causing her to become interested in science. She majored in biology at Morgan State University in Baltimore, Maryland, where she also got her master's degree. Her doctorate degree is in science education and botany. She received this degree from the University of Iowa.

Dr. Hoyle is married and the mother of two teenage children. Besides her career and family, she is active in various professional, social, and community organizations.

Her advice to young people is: "Take advantage of every educational opportunity that you may have."

Dr. Deagelia M. Pena
Associate Director for Research

Dr. Deagelia M. Pena is the associate director for research with the Affirmative Action Office at the University of Michigan. She is responsible for conducting research necessary for federal compliance in equal opportunity and developing as well as improving methods of research in affirmative action.

Dr. Pena did not like math until she was in high school. In college, she had a female professor of mathematics who encouraged her to take courses in statistics. She took them and became very interested in that field. She received fellowships which enabled her to pursue her study of statistics and mathematics. In addition, a research chairperson in education encouraged her to study for a doctorate degree.

Originally from the Philippines, Dr. Pena graduated from St. Teresa's College with a bachelor's degree in mathematics and from the University of the Philippines with a master's degree in statistics. She obtained another master's degree in mathematics from the University of Michigan where she also got her Ph.D. in educational research.

Dr. Pena has two children. She is also involved as a trustee of the Gibson School for the Gifted and participates in various professional organizations. Through the years, she made presentations on research methods at different conferences.

Her suggestions to young women are to keep an open mind about mathematics and science and not to ignore one's talents.

Dr. M. Antoinette Schiesler
Program Manager

As a program manager for the National Science Foundation (NSF), Dr. M. Antoinette Schiesler is responsible for proposals dealing with science for early adolescents, women, minorities, and the handicapped. She selects reviewers to evaluate the proposals and makes recommendations as to which should be funded.

She received her bachelor's degree in chemistry. Her master's and doctorate degrees are in science education. Dr. Schiesler is a former junior high school science teacher. She became involved in NSF programs for science teachers and wanted an opportunity to have some input into the process whereby NSF money goes to improve science education, especially for minorities and women. Now, she has such input through her job.

Dr. Schiesler is married. Her hobbies include crocheting, knitting, needlepoint, sewing, painting, guitar playing, and singing. She teaches adult education and also tutors students in math and science.

Her suggestions are to develop good study habits, read as much as possible, and not to shy away from difficult subjects like science and math.

Dr. Lois G. Fister Steele
Physician/Program Director

Dr. Lois G. Fister Steele is a medical doctor employed as the director of the INMED program at the University of North Dakota. In this position, she directs the educational and health program (INMED) that trains physicians and other allied health professionals.

Dr. Steele was once told that it would be impossible to be a doctor since she was an Indian, a single parent with two children, and lived on a reservation. She majored in zoology at Colorado College and later received a National Science Foundation fellowship that led to a master's degree in science teaching. After ten years teaching and coaching, she completed medical school and two years of family practice residency program at the University of Minnesota.

Dr. Steele has received many awards for her academic accomplishments. She is an enrolled member of the Fort Peck Assiniboine-Sioux Tribes and was raised on the Fort Peck Reservation at Poplar, Montana.

Her advice to young women is to consider a number of careers but to not underestimate yourself and remember "life is not something to be done -- it is something to be felt. It is exciting and fulfilling to practice medicine with Indian people. I would urge students to consider a health career."

RESEARCHERS

Jeanette E. Brown
Research Chemist

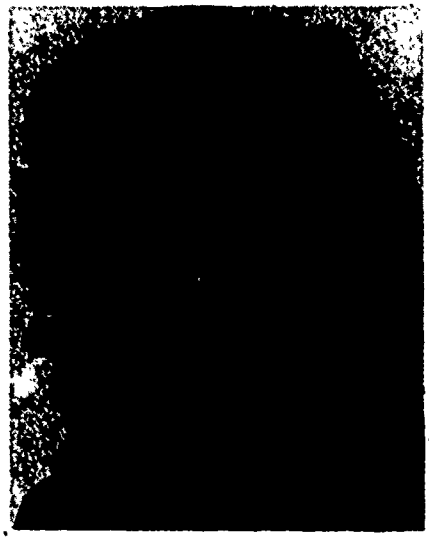
Jeanette E. Brown is presently employed by Merck and Company, Incorporated in New Jersey as a research chemist. Her duties are to design and synthesize organic compounds to be tested for biological activity as potential drugs.

Ms. Brown was inspired to enter her chemistry career by her high school chemistry teacher. She was later guided into organic chemistry by a college professor. She received her bachelor's degree from Hunter College in New York and her master's degree from the University of Minnesota in the field of organic chemistry.

Her hobbies include bicycle riding, hiking, camping, skiing, and bowling. She takes voice lessons and sings in her church choir. In addition, she is active in professional organizations such as the American Chemical Society. At her place of work, she is on a committee that works with several Black universities to interest more students to become chemists and biologists.

She recommends that young women study as much math and science as they can. She suggests they also take courses in German and/or French and not neglect their writing skills. They should apply for college as soon as possible and pursue the highest degree possible: a doctorate degree.

Dr. P. Kim Joo
Research Scientist - Seed Physiologist



Dr. P. Kim Joo is employed by the Northrup King Company in Minneapolis, Minnesota. She directs seed research projects and manages the seed quality assessment testing and technical service laboratory.

Dr. Joo was born and raised in Korea. She spent three months in a rural area as a refugee during the Korean war. She saw the poverty-stricken farmers and wanted to be an agricultural extension worker. She became one for two years after she graduated from Seoul National University with a bachelor's degree in agronomy. When she came to the United States, Dr. Joo obtained a master's degree in agronomy from Mississippi State University when a graduate research assistantship became available. Her doctorate degree is in crop physiology from Cornell University in New York.

Dr. Joo is married and has three children. She is active in the Korean American community and church. She also teaches at Korean School. She belongs to several professional organizations, and her hobbies include reading, creative writing, and nature trail hiking.

Her advice: respect oneself and try to be a capable and reliable person.

Dr. Lourminia Carino Sen
Research Biochemist/Lecturer

Dr. Lourminia Carino Sen is a research biochemist and lecturer in the Department of Food Science and Technology at the University of California in Davis. Her job responsibilities include teaching food analysis and basic enzymology courses, researching protein, and supervising the research laboratory.

Dr. Sen was born and raised in the Philippines. Her high school home economics teacher introduced her to the study of foods and nutrition. When she attended college, she became interested in food science and processing. She graduated with a degree in food technology from the University of the Philippines. Then, she immigrated to the United States and took additional courses at Oregon State University and received a degree in food science and biochemistry from the University of California at Davis.

Dr. Sen is married and has two children. She also belongs to various organizations.

Her advice is to develop a thorough understanding of the basic concepts of mathematics, physics, and chemistry. In addition, she believes that it is necessary to work hard and to learn how to organize one's time.

Dr. Lydia Villa-Komaroff
Research Scientist

Dr. Lydia Villa-Komaroff, a Chicana, is a research scientist at the University of Massachusetts Medical School. She studies gene structure using recombinant DNA technology and teaches medical and graduate students.

Dr. Villa-Komaroff has been interested in science since the age of nine. Her mother liked biology, and she was also influenced by an uncle in chemistry. A high school course encouraged her interest, and she spent the summer of her junior year at a summer science training program sponsored by the National Science Foundation.

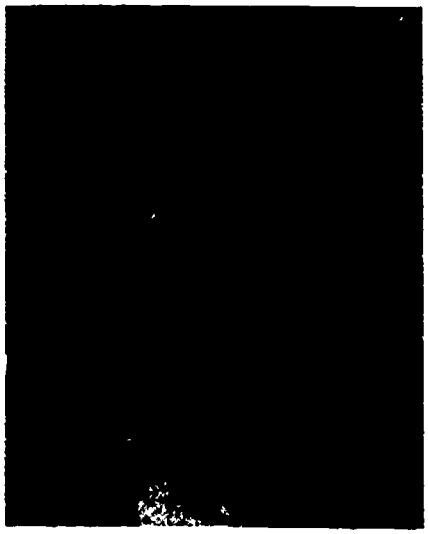
She attended the University of Washington and Goucher College in Maryland. She obtained her Ph.D. in cell biology from the Massachusetts Institute of Technology.

Dr. Villa-Komaroff has written numerous articles and received various awards and recognition in her field. Her hobbies are science fiction, gardening, and music, both classical and '60's rock.

She suggests that young women set their goals high. She feels it is a crucial issue for young women to take math in today's society. She is very interested in the impact of science and technology on society and in the elementary science education of children. She believes it is important to learn to appreciate and not be intimidated by science and technology.

SCIENCE-RELATED CAREERS

Dr. Jane Jernow
Chemist



Dr. Jane Jernow is employed by Hoffman-LaRoche in Nutley, New Jersey. She is in charge of a chemical development group that is responsible for processes in the production of pharmaceutical products such as drugs and vitamins.

Science and math have always been her favorite subjects, and she did well in them. Also, her father encouraged her to seek a science career. These factors contributed to her decision to become a chemist. She obtained her bachelor's and master's degrees from the University of Illinois. Her doctorate degree is in organic chemistry from Pennsylvania State University.

Dr. Jernow was born and raised in China. She came to the United States at the age of sixteen and became aware of the differences in attitudes toward men and women in colleges. In China, science was stressed for both males and females.

She is married and has one child. Her activities have included participation in programs for women in science.

Dr. Jernow's suggestions are to know what you want in life and be confident about what you can do when you put your mind and effort into it.

Georgia P. Dailey Pedro
District Sanitarian

Georgia P. Dailey Pedro is a district sanitarian with Indian Health Service, U.S. Public Health Service, in Sante Fe, New Mexico. Among her numerous responsibilities are designing, coordinating, and implementing a comprehensive environmental health program, i.e., water supply, solid and liquid waste disposal, vector control, plague surveillance, epidemiology, food sanitation, institutional sanitation (schools, community programs, health care facilities), safety and injury control, and rabies control. All of these areas are related to environmental health and are provided for fourteen Indian tribes in New Mexico, Colorado, and Utah.

Ms. Pedro feels that her grandfather had a great influence on her decision to go to engineering school. Her grandfather worked as a prospector for an uranium mine and described for her his experiences with surveyors, engineers, archeologists, and geologists. She attended college and received her bachelor's degree in environmental engineering from the New Mexico Institute of Mining and Technology and her master's degree in public health with an emphasis on environmental health sciences from the University of California in Berkeley.

Ms. Pedro belongs to numerous organizations. She is married and has one daughter. Her special interests include sports such as bowling, softball, volleyball, tennis, and golf. Ms. Pedro is of Laguna Pueblo descent.

She suggests that young minority women prepare themselves in the areas of science and engineering fields. They should set goals and never let anyone tell them they cannot succeed. "Education is very important, and a career is never just given to anyone. One has to work for what one wants."

Dr. F. Agnes Stroud-Schmink
Consultant in Mammalian Biology

Dr. F. Agnes Stroud-Schmink is a consultant in mammalian biology at the Los Alamos Scientific Laboratory in New Mexico. In this position, she provides information and assistance in research on radiation biology.

Dr. Stroud-Schmink received a degree in biology from the University of New Mexico and a doctorate degree in biological sciences from the University of Chicago. She has written numerous articles for professional science journals. The opportunity to meet well-known scientists from all over the world and being able to do independent research and present the findings to others have been events which have maintained her involvement in her career.

Since she is an American Indian, Dr. Stroud-Schmink has a special interest in encouraging American Indian youth to consider science careers. She is also the editor of the newsletter for the American Indian Science and Engineering Society as well as an active member of several organizations. Her hobbies are art, stamp collecting, golf, and tennis.

According to Dr. Stroud-Schmink, the negative image of science and engineering needs to be overcome. Young women should think about career-directed education in any area of science.

Becky Tanamachi
Quality Control Technician

Becky Tanamachi is a quality control technician for Petrolite Bareco Division, a company located in Texas. Her responsibilities and duties include researching and analytical testing of the chemistry of waxes. She went into this kind of work because she felt the laboratory experience would be helpful since she intends to pursue graduate work and obtain a doctorate.

Ms. Tanamachi recently graduated from Ohio State University with a degree in microbiology in 1979. She has always thought that she would be able to pursue a career in any field that she wished and hopes that young women today will believe this.

Her family has always been career oriented and encouraged her. As Japanese Americans, they were active within that ethnic community. She enjoys backpacking and rock climbing with her brother. In spite of the

fact that she "was always considered too dainty for athletic endeavors," Ms. Tanamachi enjoys participating in a variety of sports.

Her advice to young women is to seek out a goal and stick to it, and that one should "look at life careers as neither masculine or feminine . . . but give yourself a chance."

BARRIERS

It has not been easy for women, especially American Indian, Asian American, Black, and Hispanic women, to achieve careers in science and math. Besides spending several years in preparing themselves for their chosen careers, many minority women have experienced discrimination because of their race or sex or because of both race and sex.

One woman stated that it was difficult to tell whether one was being hit by racism or sexism or both. However, both kinds of discrimination hurt. This is why minority women have such a difficult time in determining what is affecting them in various situations in which they are feeling discriminated against. As one woman stated, "I have encountered numerous incidents which were primarily caused by the fact that I am a minority or a woman or both."

What kinds of discrimination have been experienced by various minority women in science and engineering? Several of the women encountered bias in counseling situations:

> Early in life, I was counseled negatively regarding a career in dentistry because that was not a career for women. I was told that it required great strength and that I would not be accepted by males in that profession.
>
> Several people in high school indicated that I might be more "realistic" in my career plans -- that is teach instead of research.
>
> My high school guidance teacher said that I'd never get a job in industry as a chemist and advised me to become a teacher.
>
> In senior high, counselors recommended pursuing a secretarial field.

Inadequate and biased counseling is a serious problem because it determines the kind of choices about careers made by young minority women in junior and senior high schools. They are discouraged from considering careers in math and science. Consequently, they may not choose to take mathematic and science courses which will, in turn, limit their career options. The women also discussed incidents which occurred during college and graduate school:

> My first advisor in college told me that women had no business in chemistry in particular and science in general -- I changed advisors.
>
> While in graduate school, I felt that some of the grades that I received were lower than they should have been because I was a Black female in a science department. I often heard remarks from male graduate students and male faculty that the laboratory was not a place for a woman, especially a Black woman.
>
> I was advised not to go into medicine by the pre-med advisor in college because I wouldn't stand a chance.

My major professor refused to allow any female student of his to pursue a research project that was intellectually stimulating.

These incidents are similar to those described earlier. Minority women continued to be discouraged by advisors and teachers. In spite of situations such as these, the women were able to attain their degrees. However, it was sometimes difficult to find a job:

I found out that it was very difficult for a woman to be an engineer in this country. My husband, also an engineer, found a good job in a week, while I had to wait one month to finally start working as a chemist. It took one and a half years before I could find a job as a chemical engineer.

A major pharmaceutical company refused to hire me after learning that I was pregnant, even though I was very much qualified. The final arrangement was to have me start working there after the baby was born -- a nine-month delay.

My initial salary offer was later found to be some $5,000 less than that offered a male with similar education but with less experience, based on his being a head of household and my being "simply an additional source of income."

When I applied for a math position at a college, even though I was the only applicant, I was not hired. The position went to an Anglo man who later got a doctorate in education. I already had received mine.

I applied to the federal government for a job, with a degree and having graduated on the Dean's Honor List. I was asked if I could type because there would be no jobs that I, as an electrical engineer, could do at that time. It is important to note that this incident made me more determined to seek and find a good, well-paying job where my professional work could be judged on its own merit.

Once in their jobs, women reported a variety of discriminatory incidents which involved them:

Being the only woman in my area, I was asked to substitute for an employee in another department when she had to be absent from work. This type of request would never be made of any of the men in my department.

I was assigned to jobs where I was over qualified and received less pay and never given any assignments in the military service where I could use my mathematics background even though I was told that this would be the case by the recruiters.

I have encountered several managers in the area I work in who are of the opinion that potential women and minority managers should first accept positions in non-technical areas before they can be ready to be considered for management positions in technical areas. Majority members do not seem to have to follow this path.

I encountered a fellow faculty member who insisted I'd get tenure because I was Indian and female, not because I was good at what I do.

It was the assumption of male members in a meeting that I would make and serve coffee and act as the secretary.

A boss did not tell me about out-of-town meetings because he assumed that I wouldn't want or be able to travel. Because I work mostly with older men, there is a tendency for them to try to "father" me which makes it difficult for me to develop my own image of authority.

Most of my supervisors seem to think that my career mostly revolves around my mate. In other words -- where he goes, I follow, no matter what my feelings are. This is not the case. They also feel that I will stay in any job, just to have a job. I plan to make career moves just as anyone would.

My job requires local travel within the company and many people wonder who I am and what position I have. This strong curiosity is basically a result of my race, sex, and age. If I were a middle-aged white male, people would just assume my position and leave it at that. People aren't accustomed to seeing a 21-year-old Black female involved in anything that appears to be difficult or important. I have also come into contact with people who have tried, obviously, to test my competence as an engineer.

I organized a symposuim and prepared the paper but received no recognition for my efforts. After I designed a research study for geology, my name was erased from it. Finally, I was pressured into writing a proposal for funding although it was not my responsibility. After funding was received, I was terminated for not doing my job!!

If my manager believes that I will fail, that belief will permeate into every business relationship I attempt to develop. It will make my job more difficult and, in effect, increase my chances of failure many times.

In a number of instances, my capabilities have been questioned. In an equal number of instances, I experienced surprise and amazement from the same persons when something was accomplished in an outstanding manner by me.

I had been called "nurse" or "miss" after properly identifying myself as a doctor.

Many of the above comments reflect the fact that employers and co-workers may expect certain things of minority women. These expectations are often based upon their stereotypes or ideas of such women.

Many women expressed the fact that they have had to work extra hard to be accepted by their male co-workers:

> Promotions are very slow for women. In the science laboratory, promotions are very slow. As the saying goes, and I earnestly believe, "A woman has to work twice as much as a man to be considered half as good." Also, men used to take my contributions slightly (little value). I am an achiever, a go-getter; but my growth is very slow.
>
> Excessive or greater effort has been required to prove one's own quality or capability. It appears to be difficult to be recognized and promotions seem to be slower.
>
> I am not as well accepted here as when I was in my native country. I have to really prove myself when I first start working or transfer from job to job. Certain positions are closed to me due to my sex and/or race.
>
> I am in a white-male-dominated field, and, therefore, encounter discriminatory actions on an almost expected basis. I have had to work extra hard to overcome some of these biases and some of these will never be overcome.

Having to work extra hard to prove oneself is not easy to do. Sometimes, it can be very frustrating. Barriers such as the negative attitudes of counselors, expectations of teachers, and treatment by employers and co-workers, have prevented many minority women from even considering a career in math and science. It may not be easy to have a career in these areas. However, the women in this book are examples of individuals who have learned ways of coping with the barriers. As one woman stated, "Like any other female that is infiltrating a traditional 'man's profession,' you will have to overcome obstacles that are, in some instances, deliberately placed in your path."

As seen in their advice to young women, the women in this book encourage others to consider a career in math and science. Such a career may not be easy, but it can be challenging and rewarding -- in spite of the barriers.

GLOSSARY OF TERMS

Archeology:
The scientific study of the life and culture of ancient people, as by excavation of ancient cities, relics, etc.

Bachelor of Arts (B.A.) and Bachelor of Science (B.S.) degrees:
Degrees given by a college or university to those who have completed a four-year course of study. The major difference is that a B.S. degree requires more credits in the science area.

Chemist:
A specialist in chemistry, e.g., biochemist, inorganic chemist, organic chemist, analytical chemist, physical chemist.

Chemistry:
The science dealing with the composition and properties of substance and with the reactions by which substances are changed into other substances.

Civil engineer:
A person who is trained in the designing and construction of highways, bridges, harbors, etc.

Computer science:
The science which deals with the design of data processing systems and the development of instructions and translation of data into machine-readable language.

Counterparts (professional):
Individuals who have similar job qualifications, duties, and responsibilities.

Data analyst:
A specialist who plans efficient methods of processing data and handling results.

Discrimination:
To make a distinction as in favor of, or against, a person or persons on the basis of race and/or sex rather than on individual merit.

Doctor of Education (Ed.D.):
A degree of the highest rank awarded by universities and some colleges for completing advanced work in graduate school in an educational field.

Doctor of Philosophy (Ph.D.):
A degree of the highest rank awarded for completing advanced graduate studies in the humanities, the social sciences, the behavioral sciences, or the pure sciences.

Environmentalist:
A person who advocates or works to protect air, water, animals, plants, and other natural resources from pollution or its effects.

Enzymology:
The scientific study of substances in plant and animal cells which stimulate chemical reactions.

Epidemiology:
The science dealing with the various single or interacting factors that cause infections and other physiological and mental diseases in human communities.

Master of Business Administration (M.B.A.):
A degree of masters conferred by a university in business administration.

Microbiology:
The science dealing with the structure, function, uses, etc. of microscopic organisms.

Plague surveillance:
The monitoring of an infectious epidemic disease that results in widespread death.

Rabies control:
Methods of eliminating or preventing the spread of an infectious virus disease of dogs, cats, bats, and other animals that can be transmitted to humans by the bite of an infected animal.

Recombinant DNA technology:
Methods of rearranging the building blocks of genes to produce new organisms.

Statistics:
Facts or data of a numerical kind, assembled and classified so as to present significant information.

Surveying:
The science or scientific method of determining the exact form, boundaries, positions, etc., (as of a track of land or section of a country) by mathematical measurements.

Zoology:
The branch of biology concerned with the animal kingdom.

APPENDIX A

Table B-8. Scientists and engineers by field, sex, and race: 1978

Field and sex	Total	Race			
		White	Black	Asian	Other
Total, all fields	2,741,400	2,621,200	41,800	53,700	24,700
Men	2,475,300	2,379,100	27,900	45,900	22,300
Women	266,100	242,100	13,800	7,800	2,400
Physical scientists	254,600	243,300	3,700	5,700	1,900
Men	231,800	222,500	3,300	4,700	1,400
Women	22,800	20,800	400	1,000	500
Chemists	173,700	164,900	3,500	3,800	1,500
Men	154,700	147,800	3,100	2,800	1,000
Women	19,000	17,100	400	1,000	500
Physicists/astronomers	61,600	59,500	200	1,600	300
Men	59,300	57,400	100	1,500	300
Women	2,200	2,200	100	(1)	(1)
Other physical scientists	19,300	18,800	(1)	300	200
Men	17,700	17,300	(1)	300	200
Women	1,500	1,500	(1)	(1)	(1)
Mathematical scientists	107,800	101,300	3,000	2,000	1,400
Men	88,000	83,100	2,000	2,000	800
Women	19,800	18,200	1,000	(1)	600
Mathematicians	97,100	91,200	2,800	1,800	1,300
Men	79,400	74,800	1,900	1,800	800
Women	17,800	16,400	900	(1)	500
Statisticians	10,700	10,100	200	200	100
Men	8,600	8,300	100	200	100
Women	2,100	1,800	100	(1)	100
Computer scientists	237,500	229,100	1,400	6,900	100
Men	194,800	189,200	1,300	4,200	100
Women	42,700	39,800	100	2,800	(1)
Environmental scientists	80,800	78,900	700	600	500
Men	72,200	70,800	400	500	500
Women	8,600	8,100	400	200	(1)
Earth scientists	70,900	69,100	700	500	500
Men	62,400	61,200	300	300	500
Women	500	8,000	400	200	(1)

See footnotes at end of table.

Source of data: U.S. Scientists and Engineers 1978, National Science Foundation, 1978, pp. 39-41.

Table B-8. Scientists and engineers by field, sex, and race: 1978
Continued

Field and sex	Total	Race			
		White	Black	Asian	Other
Oceanographers	1,600	1,400	(1)	100	(1)
Men	1,600	1,400	(1)	100	(1)
Women	(1)	(1)	(1)	(1)	(1)
Atmospheric scientists	8,300	8,300	(1)	(1)	(1)
Men	8,200	8,200	(1)	(1)	(1)
Women	100	100	(1)	(1)	(1)
Engineers	1,396,400	1,344,000	11,400	27,000	13,900
Men	1,374,600	1,324,000	10,500	26,400	13,700
Women	21,700	20,000	900	600	200
Aeronautical/astro	48,700	47,300	100	800	500
Men	47,200	45,700	100	800	500
Women	1,600	1,600	(1)	(1)	(1)
Chemical engineers	67,900	65,000	300	1,700	900
Men	65,000	62,200	300	1,600	900
Women	2,900	2,800	(1)	100	(1)
Civil engineers	183,500	176,900	1,000	4,300	1,300
Men	181,800	176,300	1,000	4,200	300
Women	1,700	600	(1)	100	1,000
Electrical/electron	243,000	229,600	3,300	8,300	1,800
Men	240,800	227,500	3,200	8,200	1,800
Women	2,200	2,000	(1)	100	(1)
Mechanical engineers	233,700	226,900	900	4,100	1,900
Men	230,400	223,600	800	4,100	1,900
Women	3,300	3,200	(1)	(1)	(1)
Other engineers	619,500	598,300	5,900	7,800	7,500
Men	609,500	589,600	5,100	7,500	7,300
Women	10,000	8,700	800	300	200
Life scientists	327,600	313,100	6,700	5,900	1,900
Men	255,400	245,100	5,500	3,600	1,200
Women	72,200	68,000	1,200	2,300	700
Biologists	153,500	145,000	2,800	4,500	1,100
Men	110,700	105,700	1,800	2,500	700
Women	42,800	39,300	1,100	2,000	500
Agricultural scientists	130,400	125,200	3,600	1,000	600
Men	121,700	116,900	3,600	800	400
Women	8,700	8,400	(1)	200	200

Table 3-8. Scientists and engineers by field, sex, and race: 1978
Continued

Field and sex	Total	Race			
		White	Black	Asian	Other
Medical scientists	43,600	42,900	200	400	200
Men	23,000	22,500	100	300	100
Women	20,700	20,400	100	100	100
Psychologists	131,700	127,000	3,700	100	800
Men	95,700	93,600	1,300	100	600
Women	36,000	33,400	2,400	(1)	200
Social scientists	205,100	184,600	11,000	5,400	4,000
Men	162,800	150,800	3,600	4,500	3,900
Women	42,200	33,800	7,500	900	100
Economists	59,000	57,500	100	800	500
Men	52,300	51,000	100	700	500
Women	6,600	6,500	(1)	100	(1)
Sociologists/anthro.	44,500	36,400	5,400	400	2,300
Men	29,100	23,900	2,900	100	2,200
Women	15,400	12,500	2,500	300	100
Other social scientists	101,600	90,700	5,500	4,200	1,200
Men	81,400	75,900	600	3,700	1,200
Women	20,200	14,700	4,900	500	(1)

1/ Too few cases to estimate.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation

APPENDIX B

FIELDS OF STUDY REQUIRING HIGH SCHOOL PREPARATION IN MATHEMATICS AND SCIENCE

Architecture

Four years of high school college prep math or equivalent.

Astronomy

Four years of high school college prep math or equivalent; high school physics and chemistry.

Biology

Four years of high school college prep math or equivalent; high school chemistry, biology, and physics.

Botany

Four years of high school college prep math or equivalent; high school biology and physics.

Business Administration

Four years of high school college prep math or equivalent.

Chemistry

Four years of high school college prep math or equivalent; one unit each of chemistry and physics; three units of German.

Clinical Dietetics

Four years of high school college prep math or equivalent; one year of high school chemistry.

Computer Sciences

Four years of high school college prep math or equivalent; one year of high school biology, chemistry, and physics recommended.

Dental Hygiene

Four years of high school college prep math or equivalent; high school biology, chemistry, and physics recommended.

Economics

Three years of high school college prep math or equivalent; four years strongly recommended.

Engineering

Four years of high school college prep math or equivalent; one year of high school physics and one year of high school chemistry.

Environmental Health

Four years of high school college prep math or equivalent; one year each of high school biology, chemistry, and physics.

Fisheries

Four years of high school college prep math or equivalent.

Geological Sciences

At least three units of high school math; one unit each of high school physics and chemistry.

Medicine

Four years of high school college prep math or equivalent; one year each of high school chemistry, biology, and physics.

Nursing

It is recommended that students take physics, chemistry, and math at least to the level of trigonometry in high school.

Nutritional Science and Textiles

Four years of high school college prep math or equivalent; one year of high school chemistry.

Occupational Therapy

Four years of high school college prep math or equivalent.

Oceanography

Four years of high school college prep math or equivalent; one year each of high school chemistry, physics, and biology.

Pharmacy

Four years of high school college prep math or equivalent; one year each of chemistry, biology, and physics.

Physical Therapy

Four years of high school college prep math or equivalent.

Physics

Four years of high school college prep math or equivalent; high school chemistry and physics.

Psychology

One program requires three years of high school college prep math; the more rigorous program requires four years of high school college prep math or equivalent and high school chemistry or physics recommended.

Quantitative Science

Four years of high school college prep math or equivalent.

Rehabilitation Medicine

Four years of high school college prep math or equivalent.

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